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PATENT SPECIFICATION

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800,414

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International Classification:—B23p. C23c.

COMPLETE SPECIFICATION

Improvements in or relating to the Manufacture of Blades for Rotary Machines, for Example Compressors or Turbines

We, ROLLS-ROYCE LIMITED, a British Company, of Nightingale Road, Derby, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention comprises improvements in or relating to the manufacture of blades for rotary machines, for example turbines or compressors.

It is often necessary in rotary machines, such as turbines or compressors, to employ blades having internal passages to carry a flow of fluid. For instance, in gas turbines, the operating temperature which should be as high as possible, is limited by the hot strength of the blades of the turbine, and in order to increase the operating temperatures it is known to provide passages in the turbine blades and to pass a cooling fluid through the passages. Such passages are desirably of small cross-section and difficulties are experienced in forming them in cast or forged blades.

This invention has for an object to provide an improved method of manufacture of blades with internal passages.

According to this invention, a method of manufacturing a blade with internal fluid passages comprises the steps of producing an aerofoil blade blank which has one working surface, say the concave surface, or both its working surfaces formed with a plurality of grooves having the positions and dimensions of the desired internal fluid passages, filling the grooves with a filler material which is capable of being plated by a vapour deposition process and which is capable of being removed after plating without damage to the blank or deposited coating, subjecting the blank with filled grooves to a vapour deposition process to convert the grooves into internal passages, and then removing the filler material.

The coating is preferably applied over the whole blade blank and may be a metal such as nickel or chromium, or a carbide, nitride, boride, silicide, or oxide of a suitable metal, or a ceramic material.

The filler may be removed by, for instance, heating the coated blade and in this case the filler may be a low melting point metal, such as lead, tin and zinc, or by chemical action in which case the filler material may be for instance, plastic wood, wood pulp, wax etc. The method employed for the filler material removal is selected according to the nature of the filler material and of the coating.

The present invention also includes a blade when produced by the foregoing method.

Some forms of blade produced by the method of this invention will now be described with reference to the accompanying drawings, in which:—

Figure 1 shows a blade fitted in the periphery of a turbine disc,

Figure 2 is a view in the direction of arrow 2 on Figure 1,

Figure 3 is a section on the line 3—3 of Figure 1, and

Figure 4 shows part of a modified form of blade.

Referring first to Figures 1 to 3, the blade comprises an operative portion 10 which projects from a blade platform 11 which in use defines part of the wall of the working fluid passage of the turbine, and the platform is connected to an integral fir tree root-fixing portion 12 by a stem 13. The blade illustrated has in its operative portion 10 sets of longitudinal passages 16 close to its convex and concave surfaces, the passages 16 being connected by drilled holes 17 to a large diameter hole 18 drilled through the stem 13 parallel to the turbine axis. The hole 18 provides a distribution passage through which cooling fluid is fed to the passages 16. The other ends of the passages 16 are either narrowed as indicated at 16*a* to provide small cross-section outlets from the blades, or terminate in small drilled holes 16*b* (Figure 4) passing through a part of the blade,

such as a tip shroud 19.

In addition the blade may have other passages or cavities 20 formed therein at positions between the covered-groove sets either during casting of the blank or by drilling the blank, or the coated blade.

The blade is made by producing a blank 14 (see Figure 3) having a part corresponding to the operative portion 10 of the blade, this part of the blank being grooved on its surfaces, the platform 11, stem 13 and root fixing portion 12, and, where provided, a tip shroud 19. The drillings 17, 16*b* are formed and then after filling the grooves with a suitable filler, the blank is plated as indicated at 15 by a vapour deposition process.

After coating of the blank, the material filling the grooves is removed.

WHAT WE CLAIM IS:—

1. A method of manufacturing a blade with internal fluid passages comprising the steps of producing an aerofoil blade blank which has one working surface, or both its working surfaces formed with a plurality of grooves having the positions and dimensions of the desired internal fluid passages, filling the grooves with a filler material which is capable of being plated by a vapour deposition process and which is capable of being removed after plating without damage to the blank or deposited coating, subjecting the blank with filled grooves to a vapour deposition process to convert the grooves into internal passages, and then removing the filler material.

2. A method according to claim 1, wherein the whole blade blank is coated in the vapour deposition process.

3. A method according to claim 1 or claim 2, wherein the coating material is a metal such as nickel or chromium, or a carbide nitride boride, silicide, or oxide of a suitable metal, or a ceramic material.

4. A method according to claim 1 or claim 2 or claim 3, wherein the filler material is selected to have a low melting point and is removed by heating the plated blade.

5. A method according to claim 1 or claim 2 or claim 3, wherein the filler material is removed by chemical action.

6. A blade when produced by the method of any of claims 1 to 5.

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PROVISIONAL SPECIFICATION

Improvements in or relating to the Manufacture of Blades for Rotary Machines, for Example Compressors or Turbines

We, ROLLS-ROYCE LIMITED, a British Company, of Nightingale Road, Derby, do hereby declare this invention to be described in the following statement:—

This invention comprises improvements in or relating to blades for rotary machines, such as turbines or compressors, and to the manufacture of such blades.

It is often necessary in rotary machines, such as turbines or compressors, to employ blades having internal passages to carry a flow of a fluid. For instance, in gas turbines, the operating temperature which should be as high as possible, is limited by the hot strength of the blades of the turbine, and in order to increase the operating temperatures it is known to provide passages in the turbine blades and to pass a cooling fluid through the passages. Such passages are desirably of small cross-section and difficulties are experienced in forming them in cast or forged blades.

This invention has for an object to provide an improved method of manufacture of blades with internal passages.

According to this invention, a method of manufacture of a blade with internal fluid passages comprises the steps of producing an aerofoil blade blank which has one surface, say the concave surface, or both its surfaces formed with a plurality of grooves having the positions and dimensions of the desired internal fluid passages filling the grooves with a filler material which is capable of being plated by a vapour deposition process and which is capable of being removed after plating without damage to the blank or deposited coating, subjecting the blank with filled grooves to a vapour deposition process to convert the grooves into internal passages, and then removing the filler material.

The coating is preferably applied over the whole blade blank and may be a metal such as nickel or chromium, or a carbide, nitride, boride silicide, or oxide of a suitable metal, or a ceramic material.

The filler may be removed by, for instance, heating the coated blade and in this case the filler may be a low melting point metal, such as lead, tin and zinc, or by chemical action in which case the filler material may be for instance plastic wood, wood pulp, wax etc. The method employed for the filler material removal is selected according to the nature of the filler material and of the coating.

The present invention also includes a blade when produced by the foregoing method.

In one form of turbine blade of this invention, the operative portion of the blade springs from a blade platform, which in use defines part of the wall of the working fluid passage of the turbine, and the platform is connected to an integral fir tree root-fixing portion by a stem. The blank prior to plating comprises, in addition to the operative part grooved on each

surface, the whole of the platform, the stem and the root fixing. The stem has a hole drilled through it to be parallel in use to the turbine axis and to provide a distribution passage for the cooling fluid and the grooves are each connected at one end to the distribution passage by means of a small drilled hole, which can be readily produced prior to plating. The other ends of the grooves either are narrowed to provide small cross-section outlets from the blades, or terminate in small drilled holes passing through a part of the blade, such as a tip shroud, which is formed as part of the blank so that the drilled holes can be produced prior to plating.

In addition to the holes formed by covering the grooves in the blank surfaces, the blade may have other passages or cavities formed therein at positions between the covered-groove sets either during casting of the blank or by drilling the blank, or the coated blade.

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111 & 112, Hatton Garden, London, E.C.1,
Chartered Patent Agents.

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Fig.1.

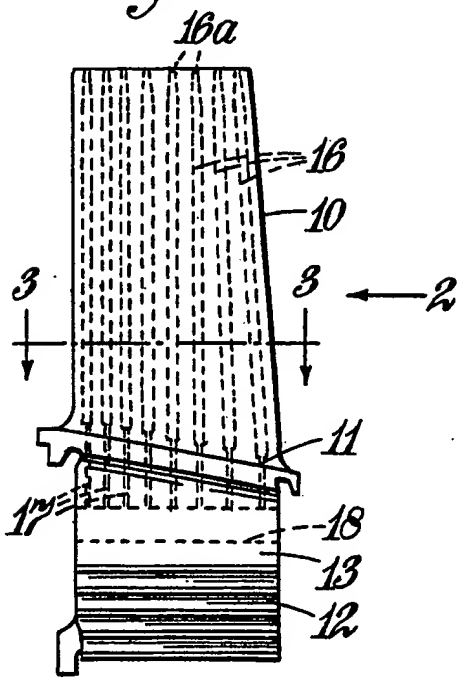

Fig.2.

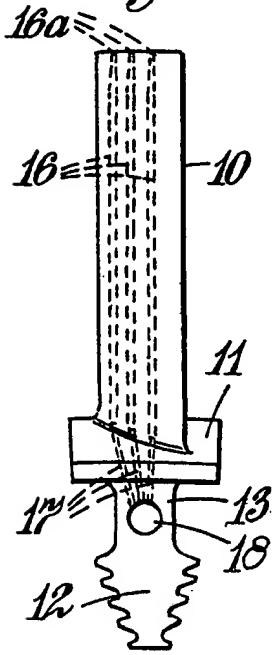

Fig.3.

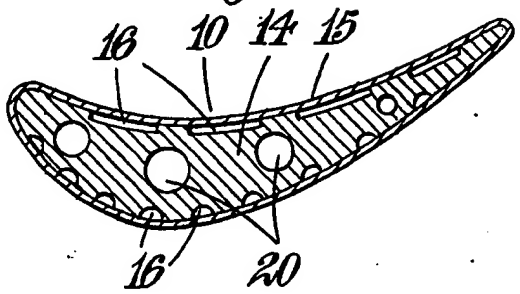

Fig.4.